SACRED-MA:
Safe And seCure REmote Direct Memory Access

VeTTS 2024

Guillaume Ambal[1], Gregory Chockler[2], Brijesh Dongol[2],
Milad Ketabi[2], Azalea Raad[1]

[1]Imperial College London, [2]University of Surrey

May 21, 2024

RDMA example

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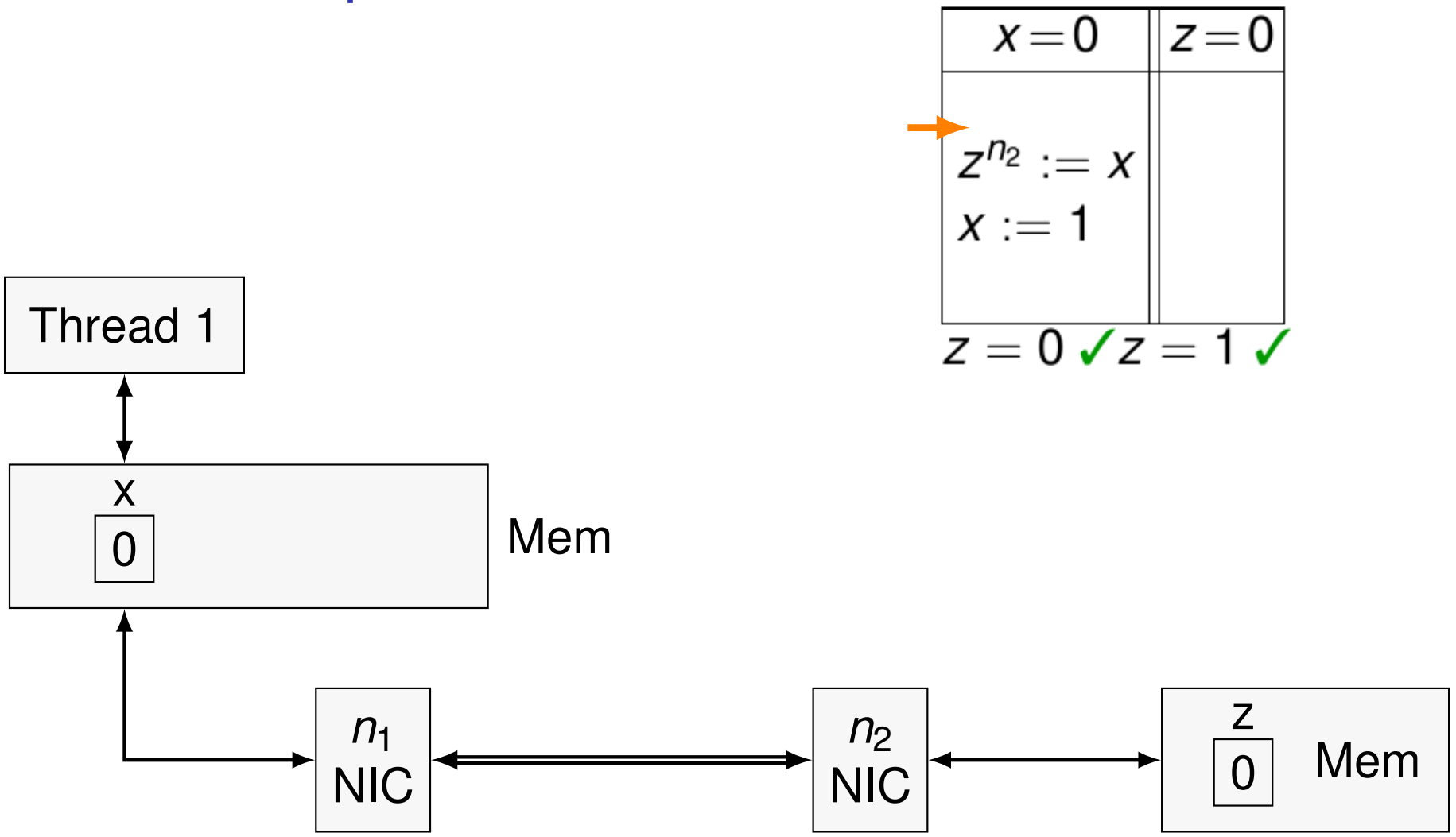

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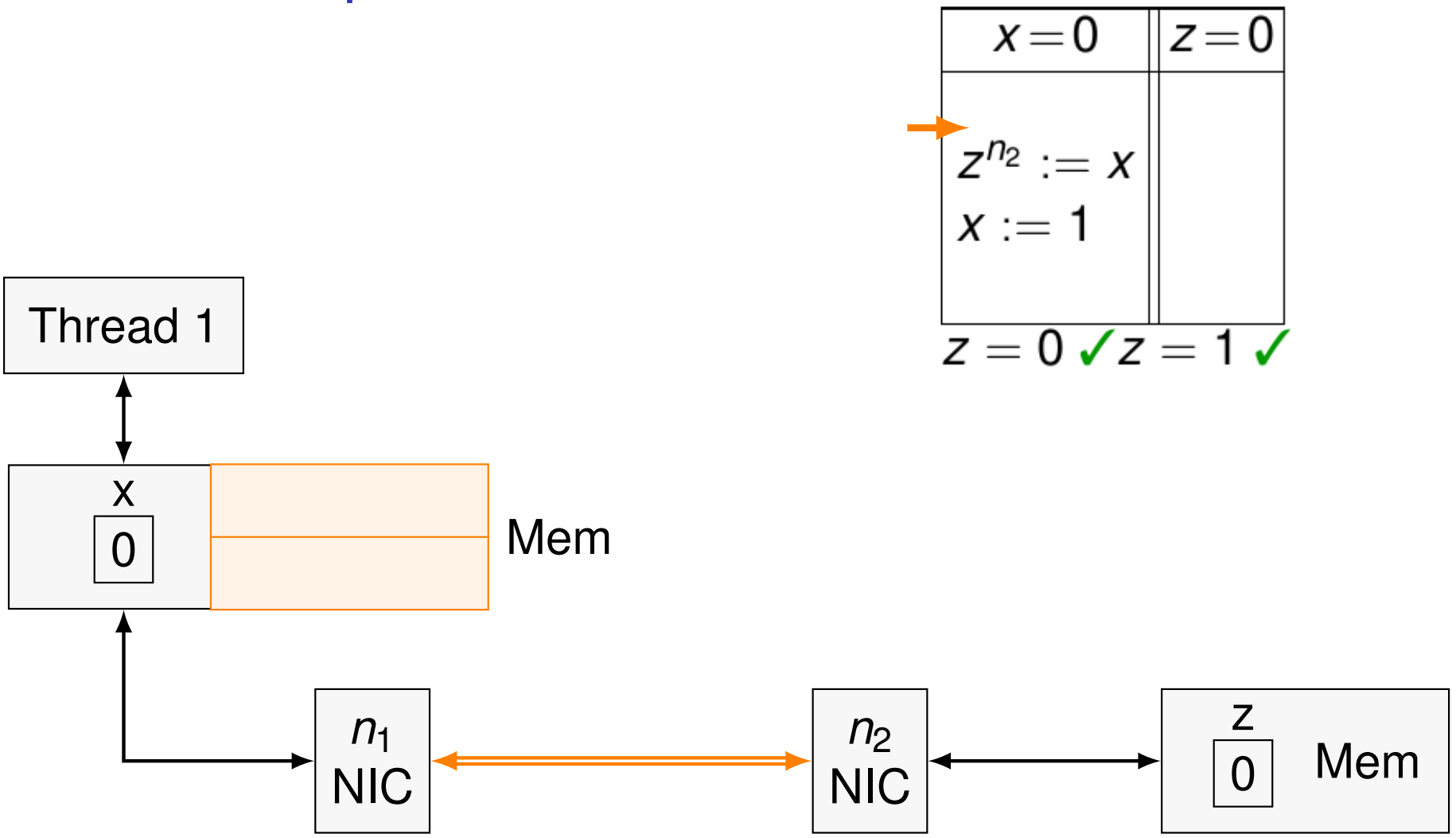

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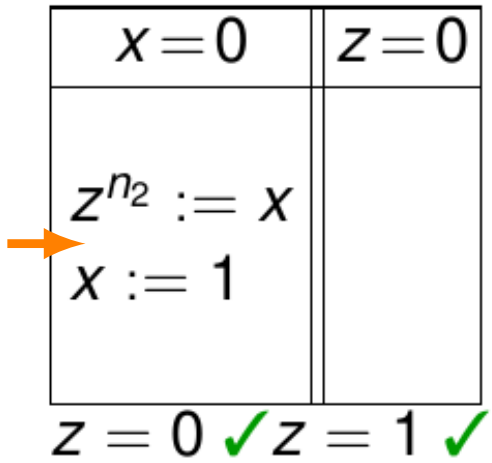

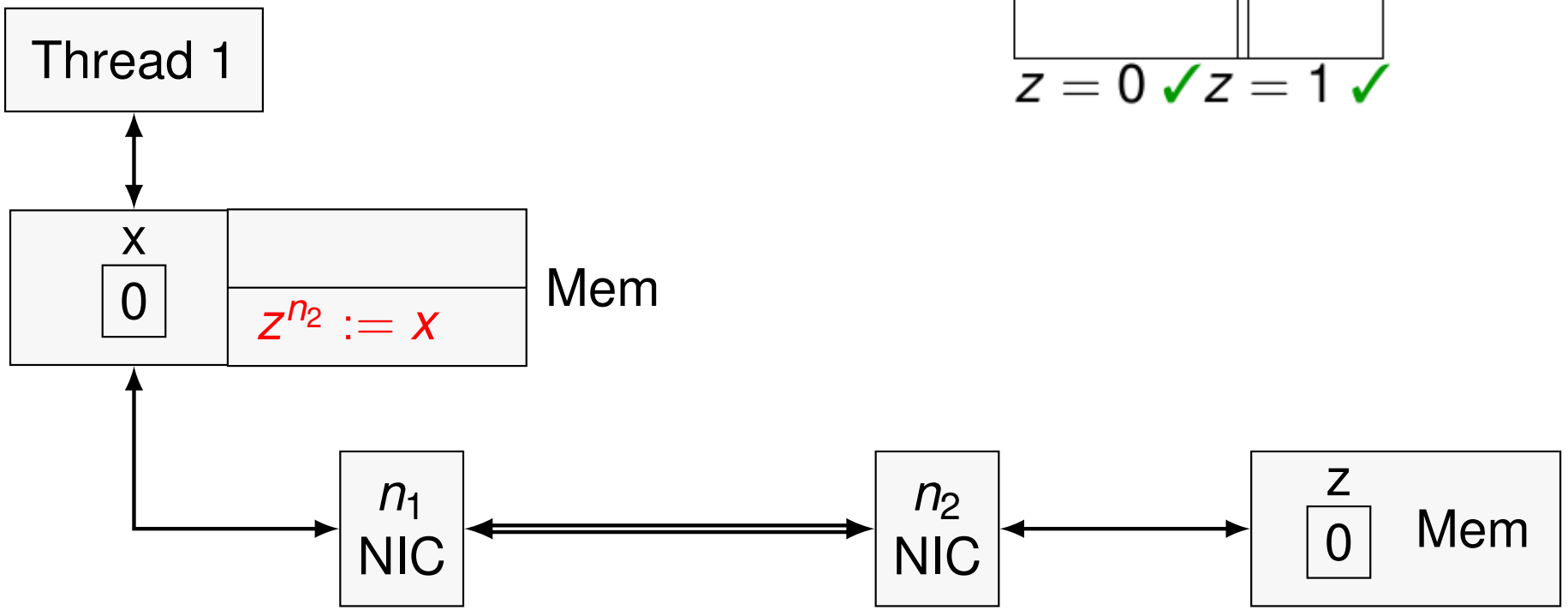

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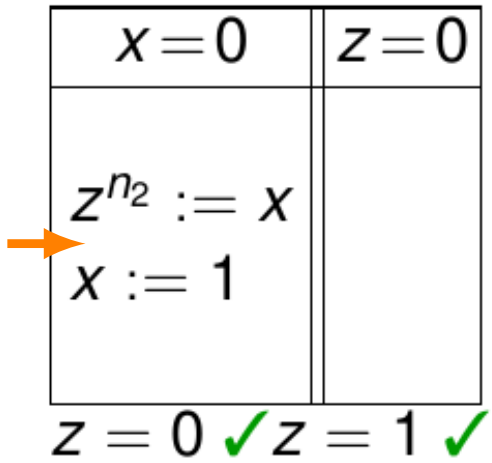

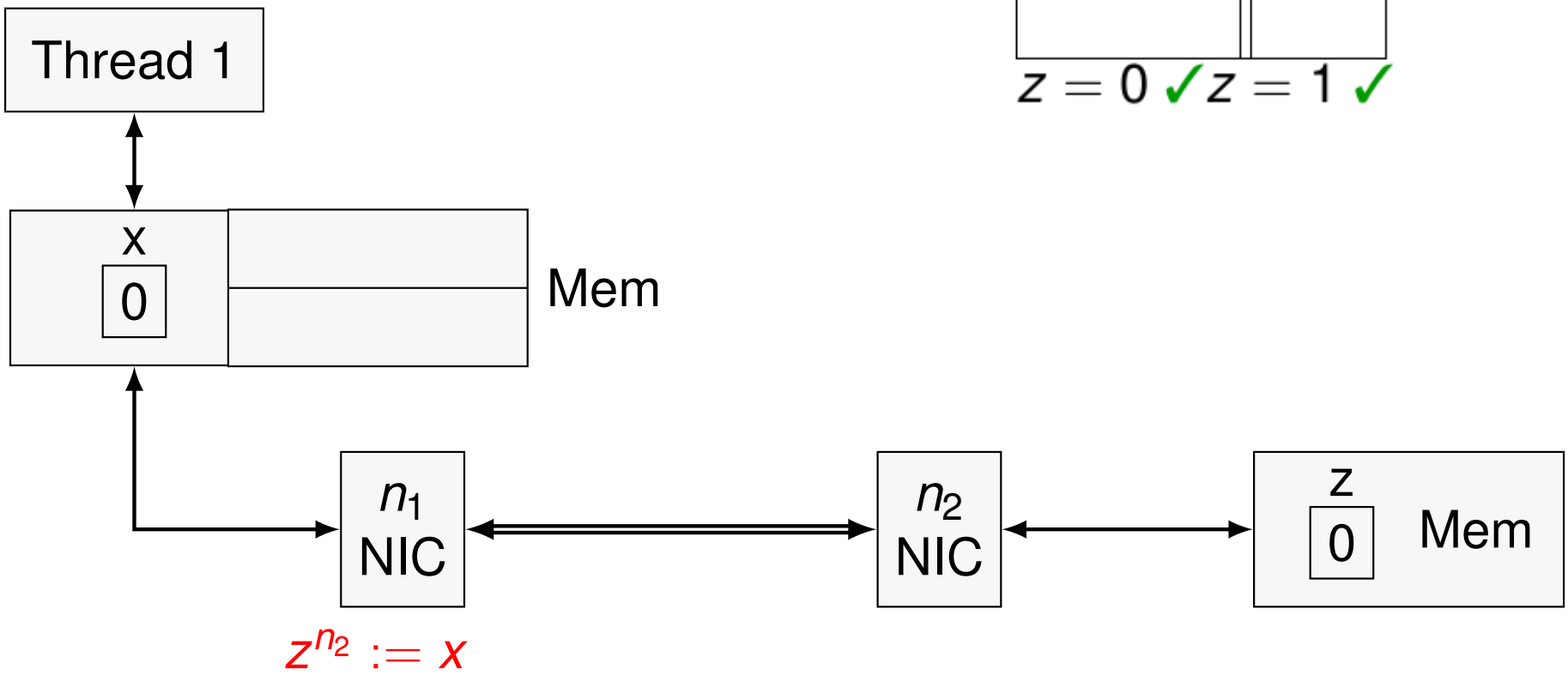

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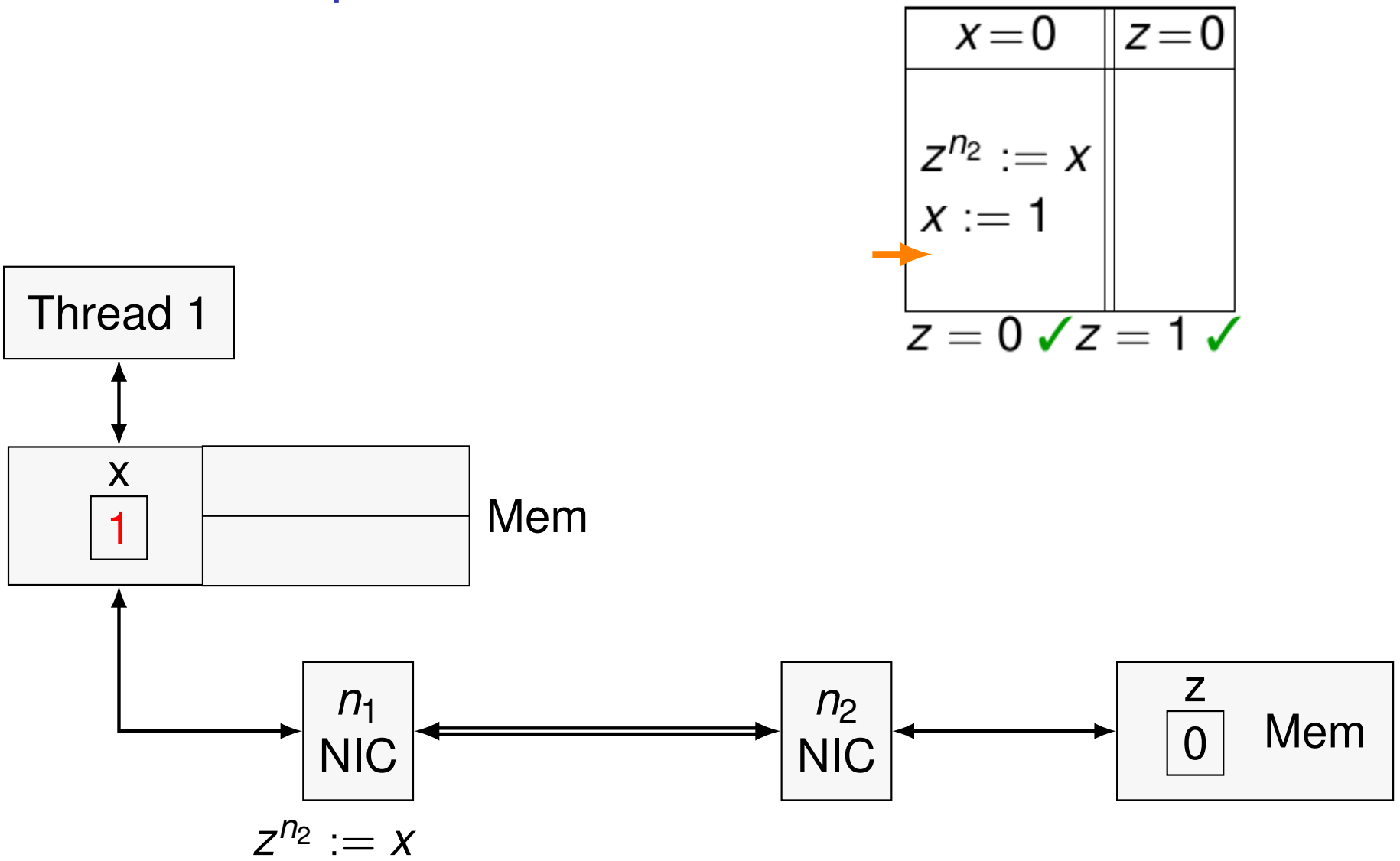

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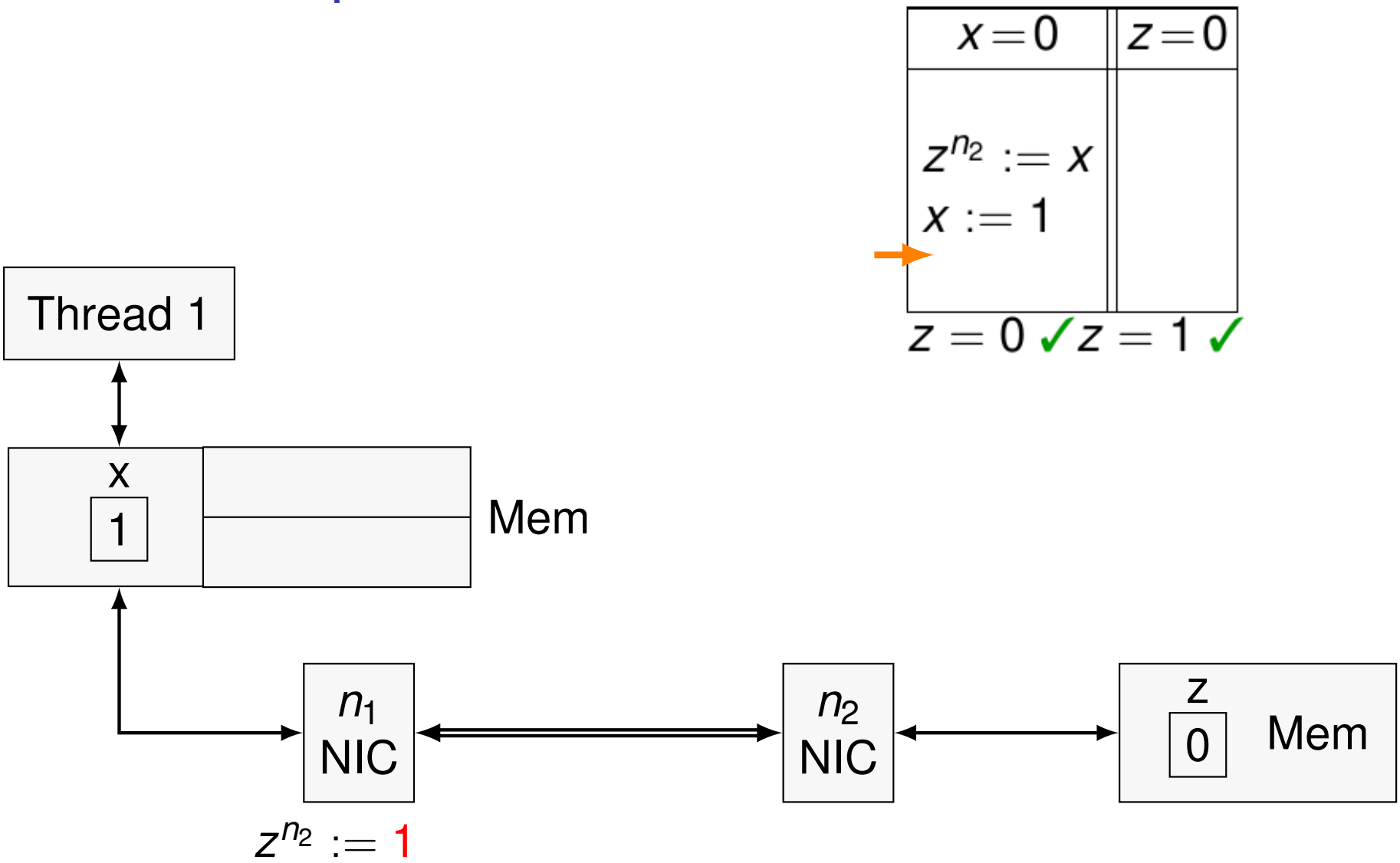

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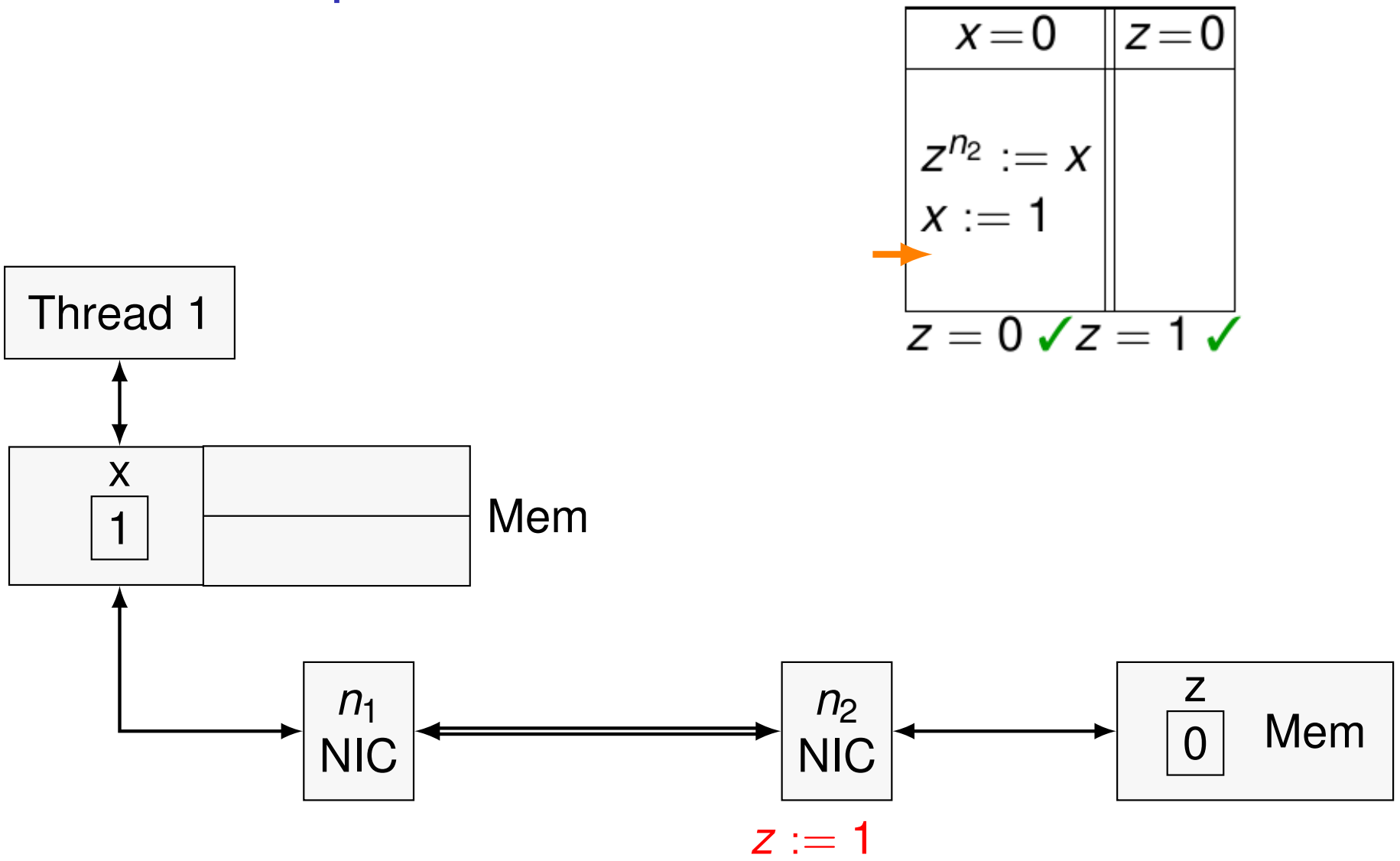

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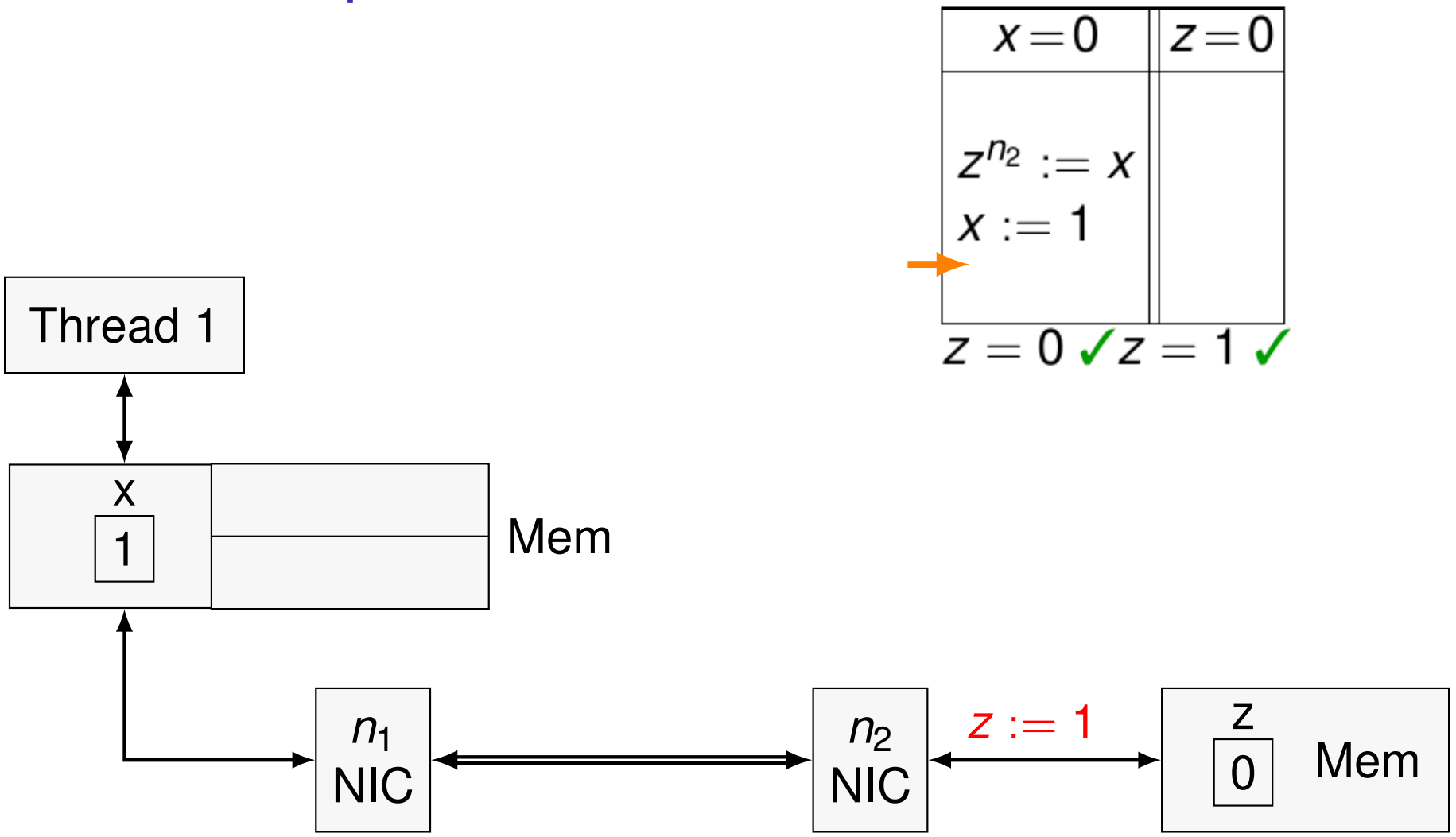

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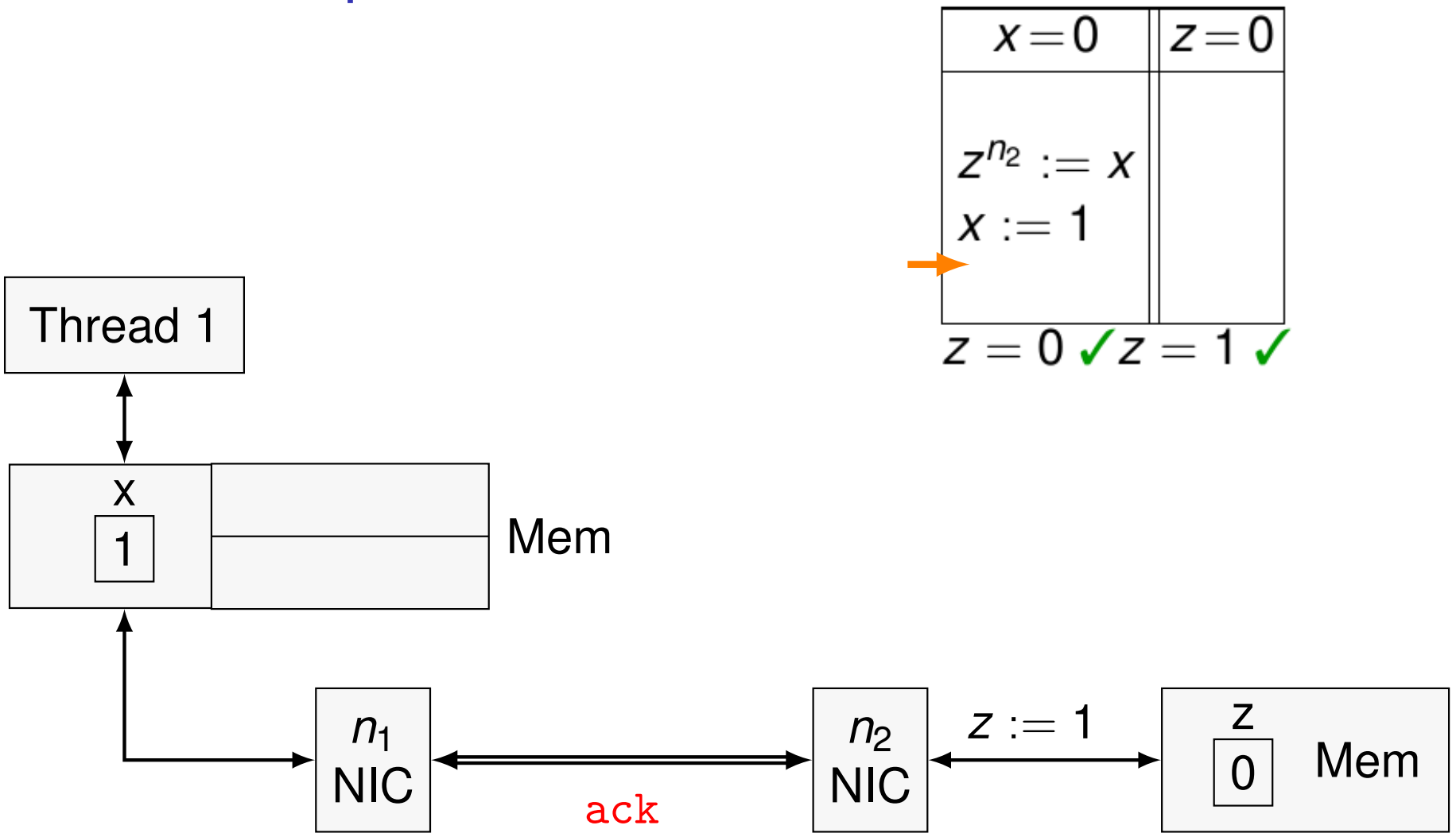

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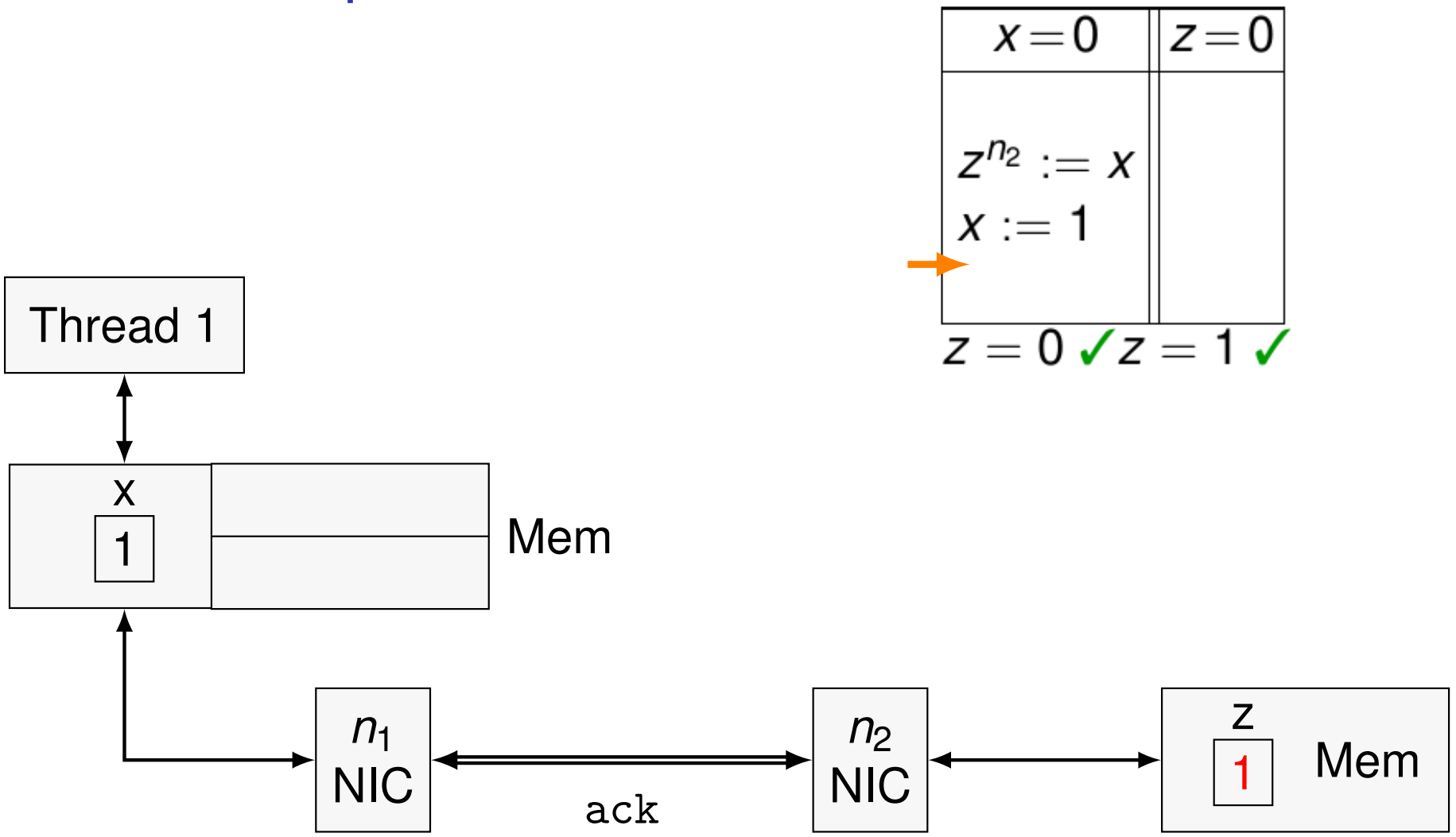

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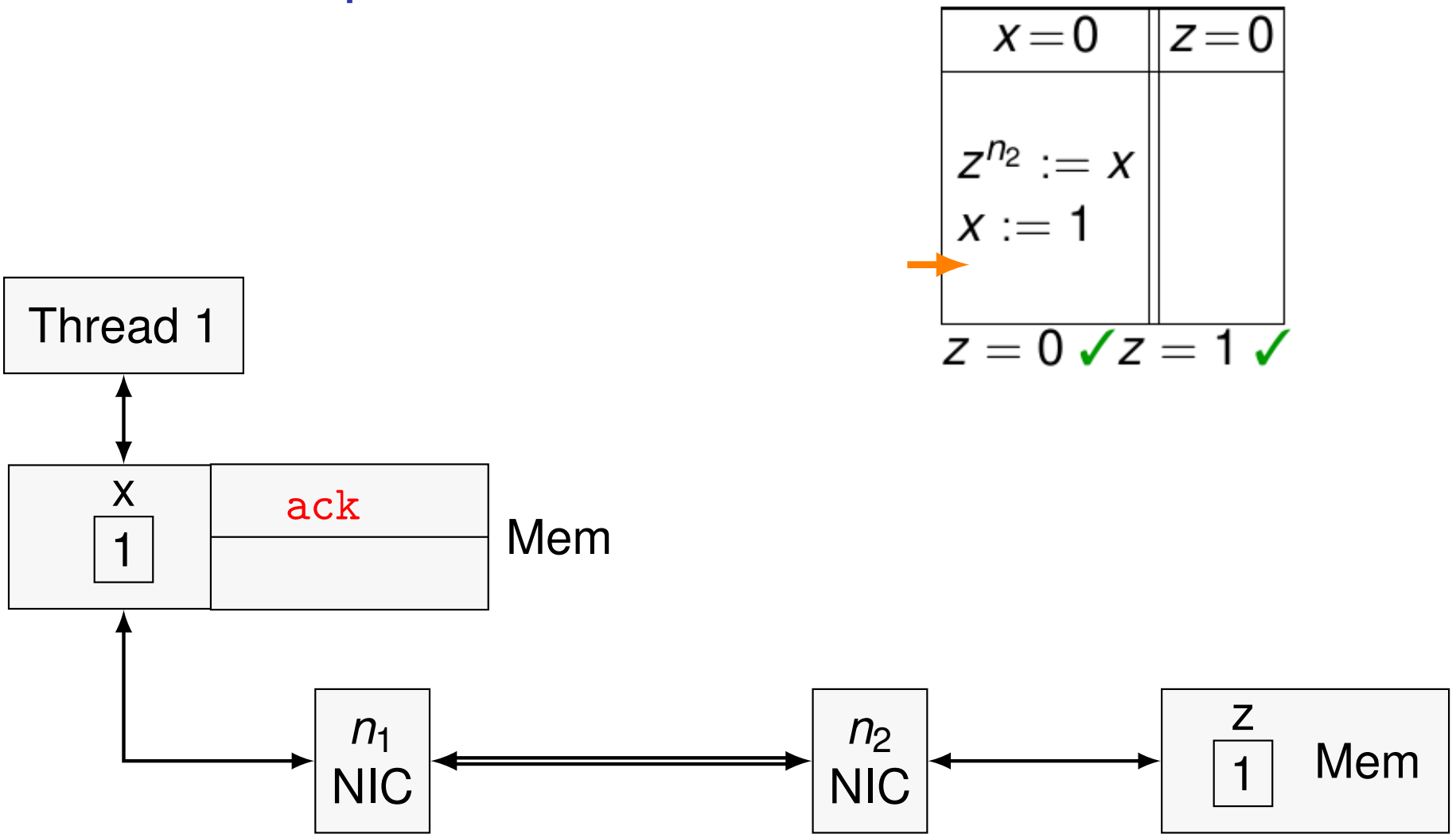

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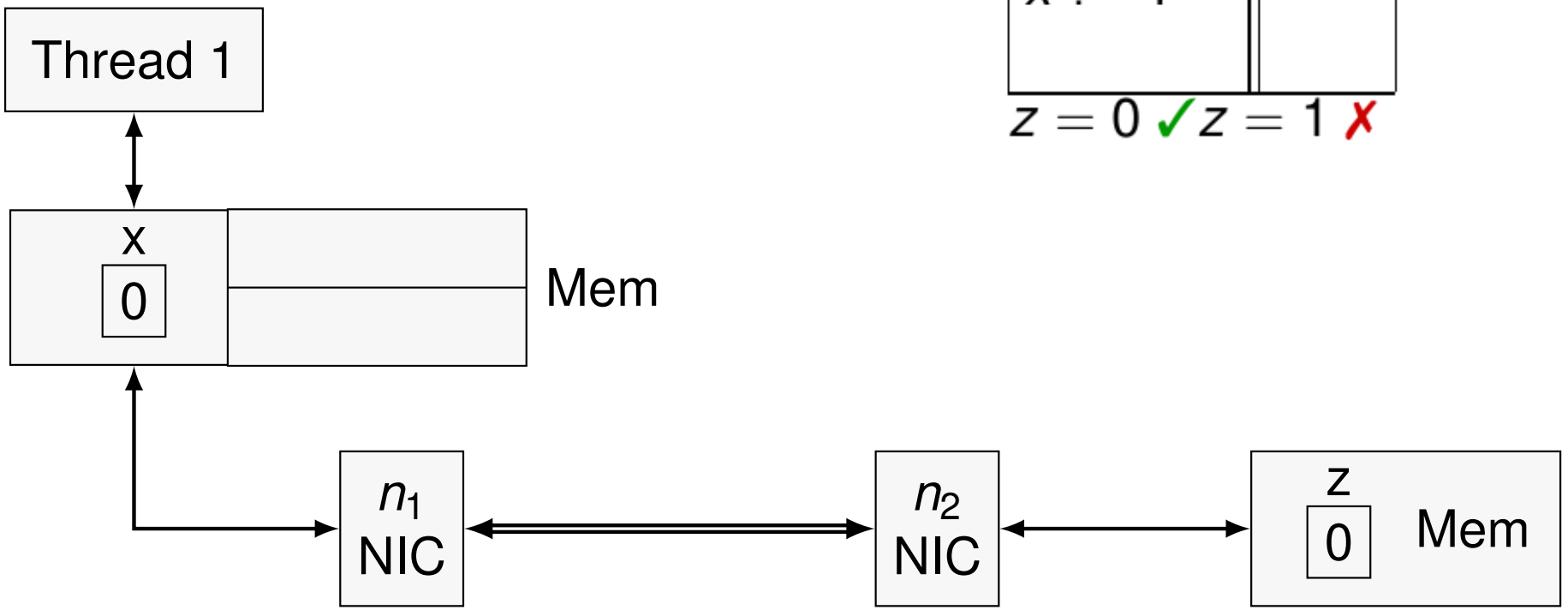

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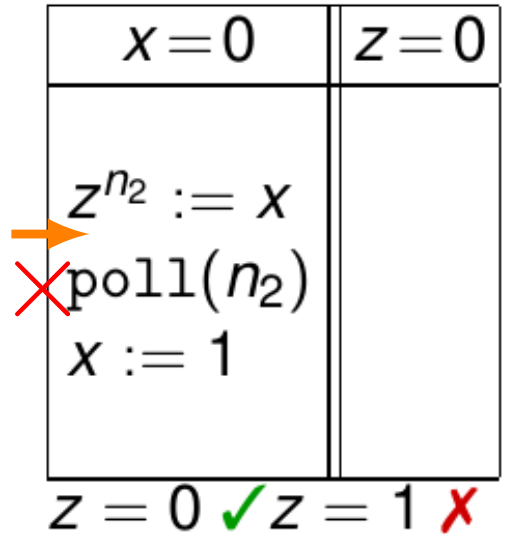

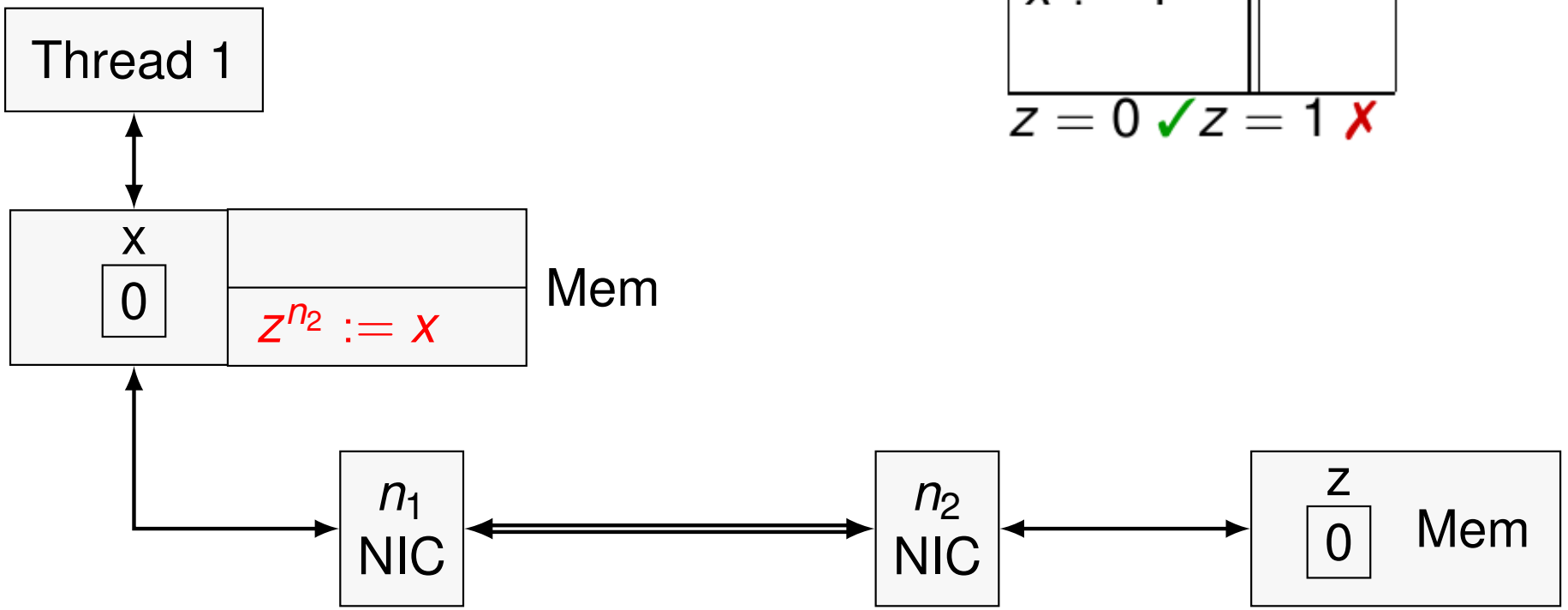

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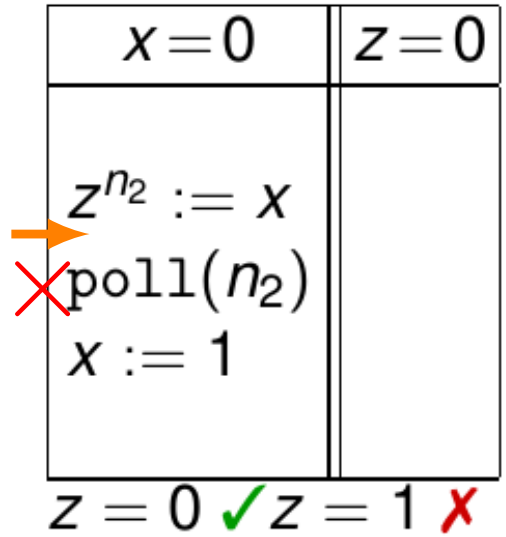

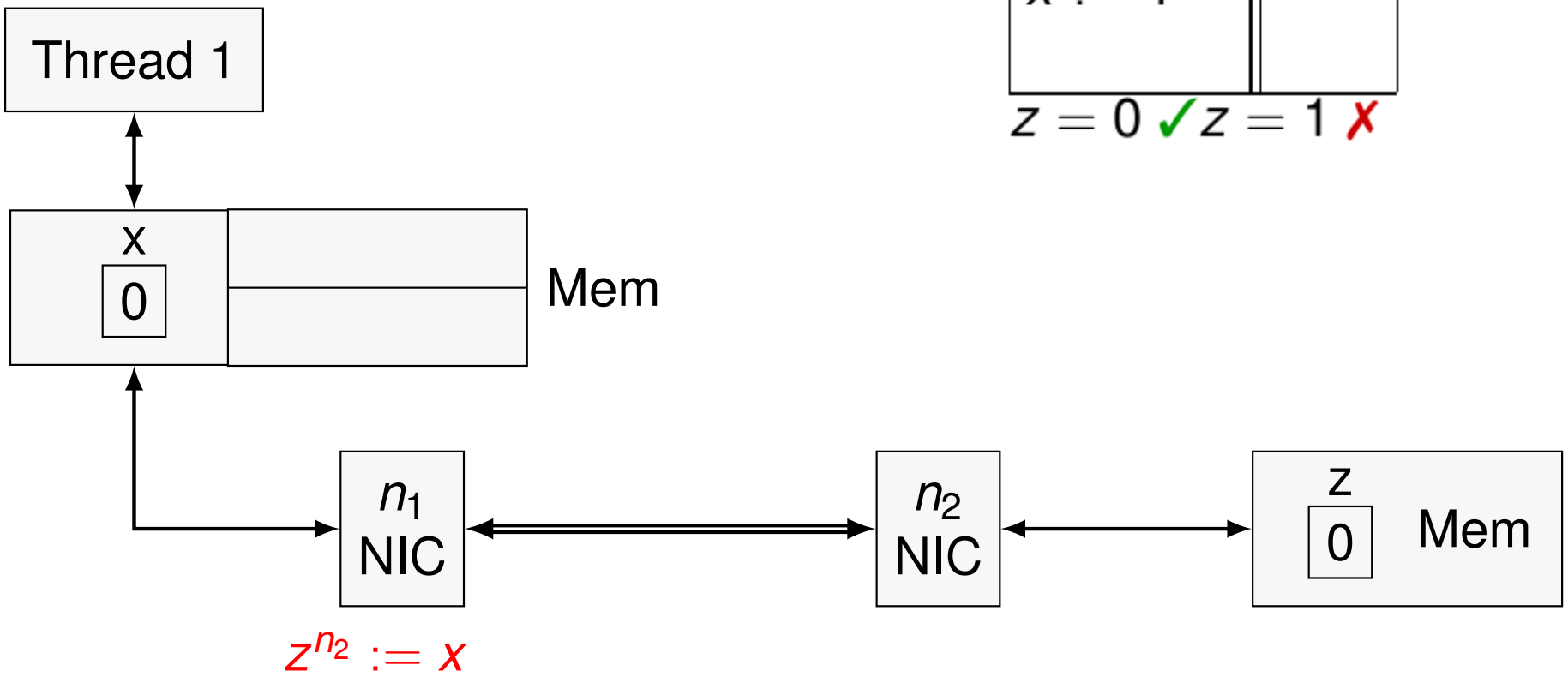

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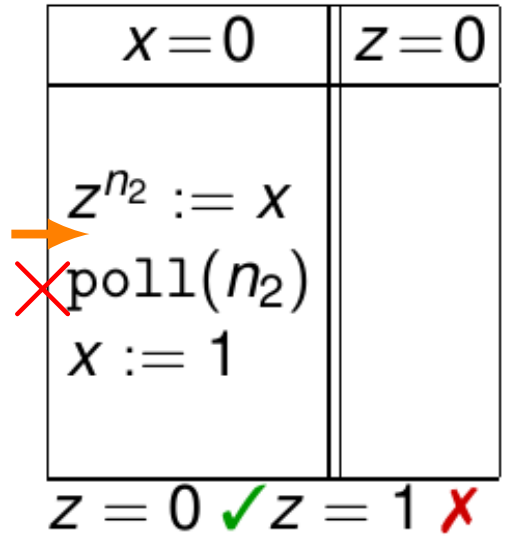

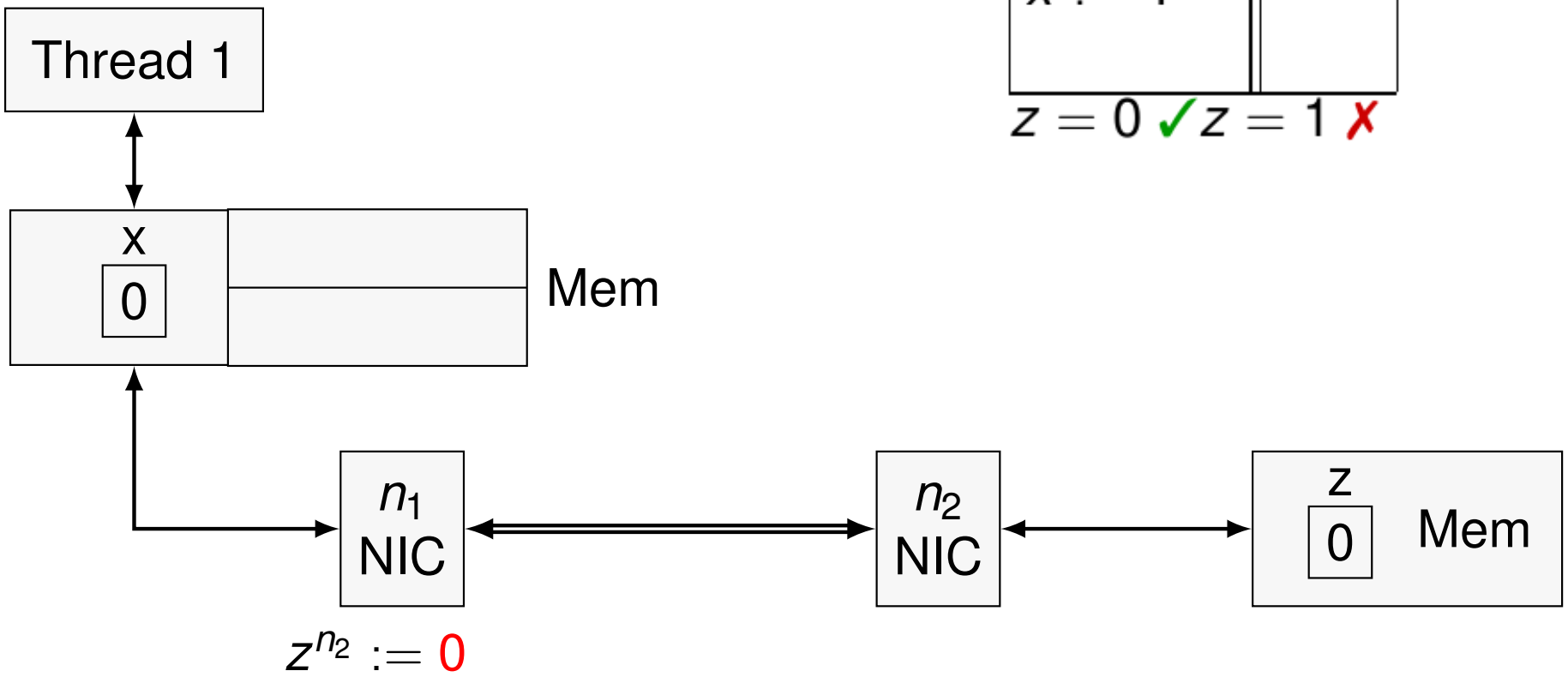

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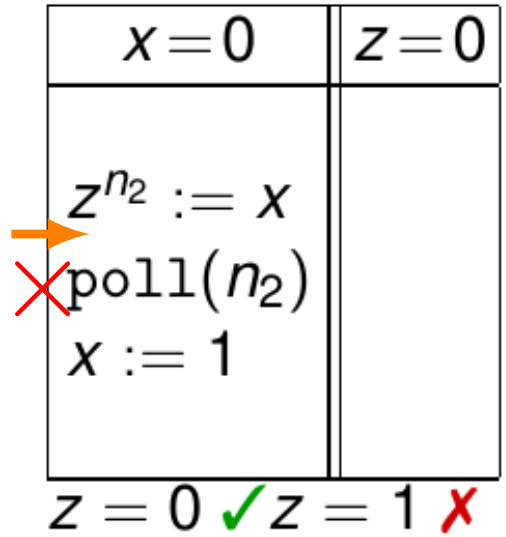

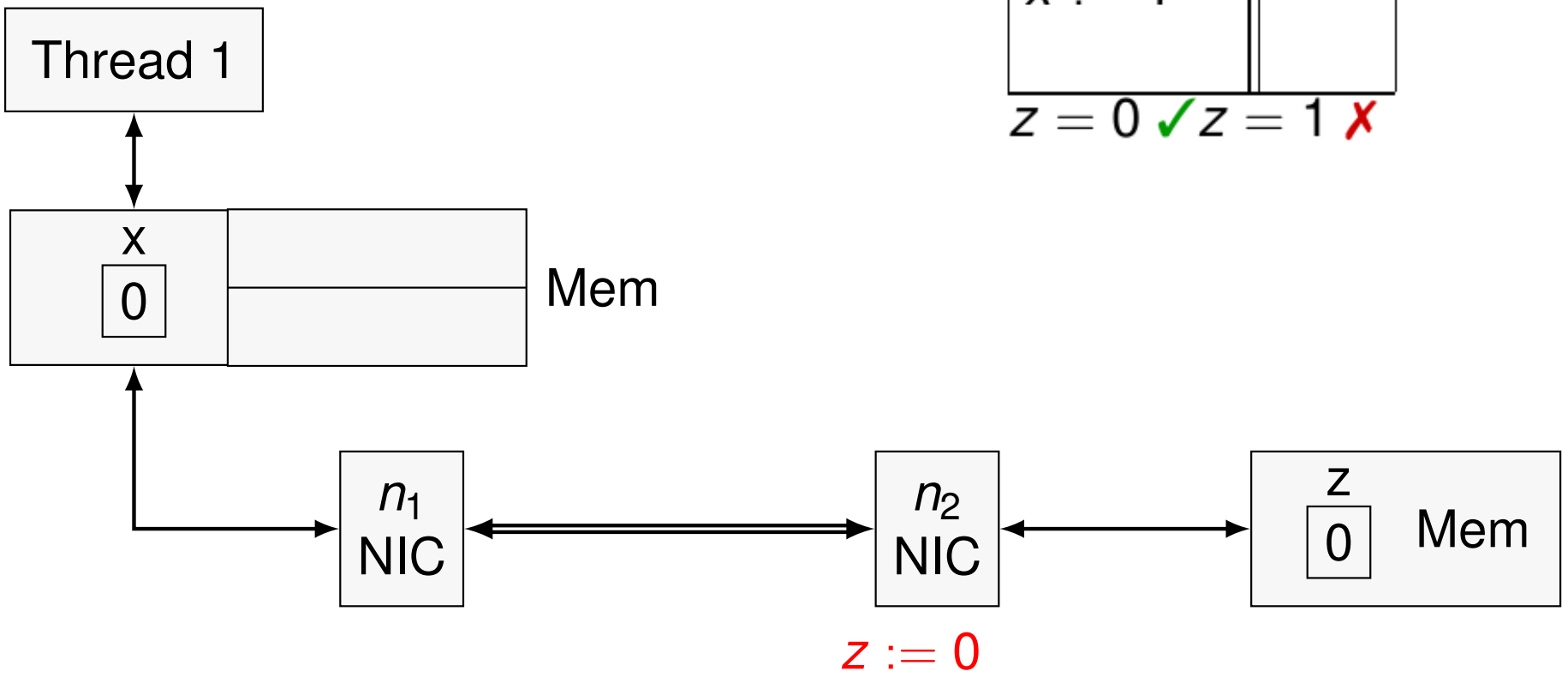

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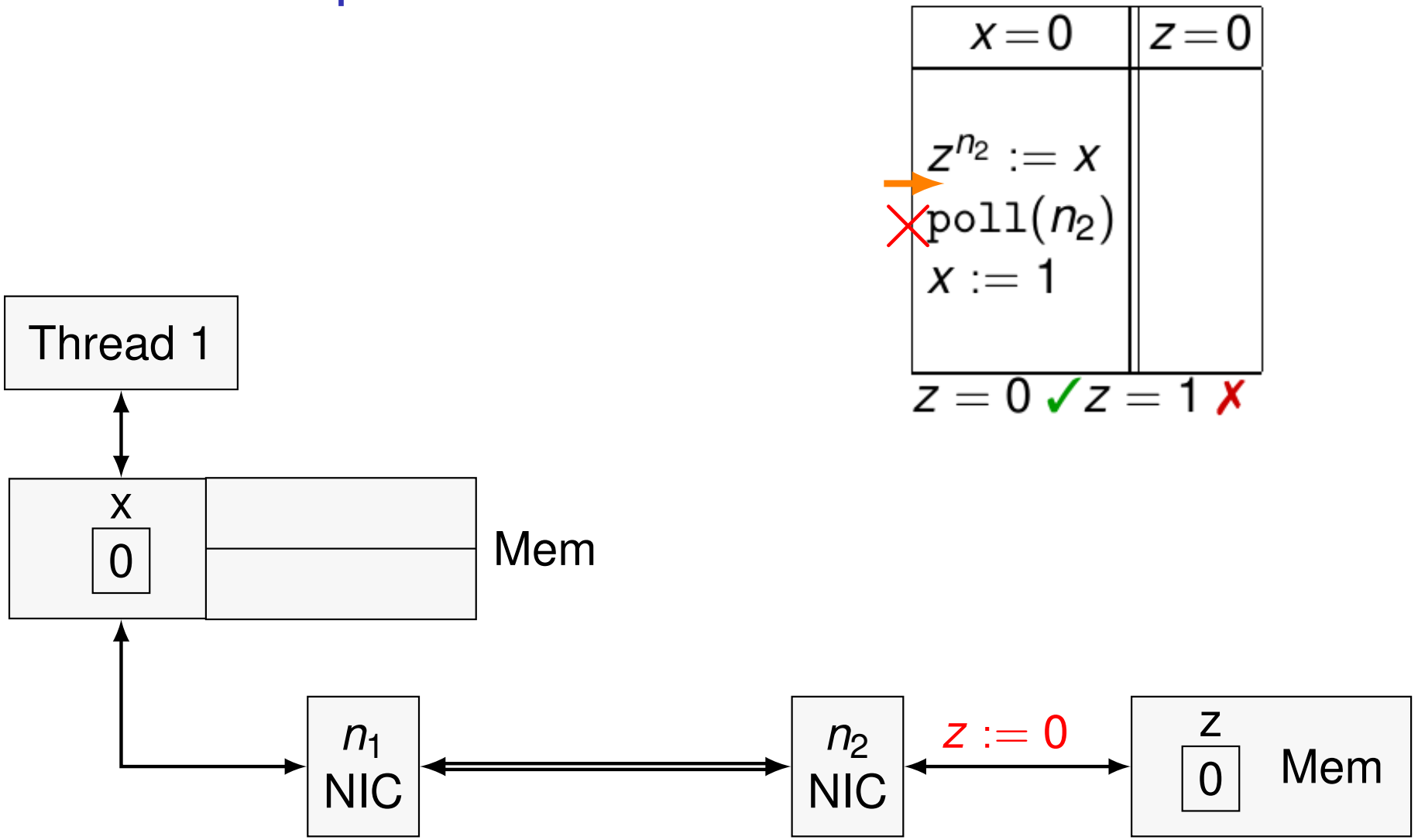

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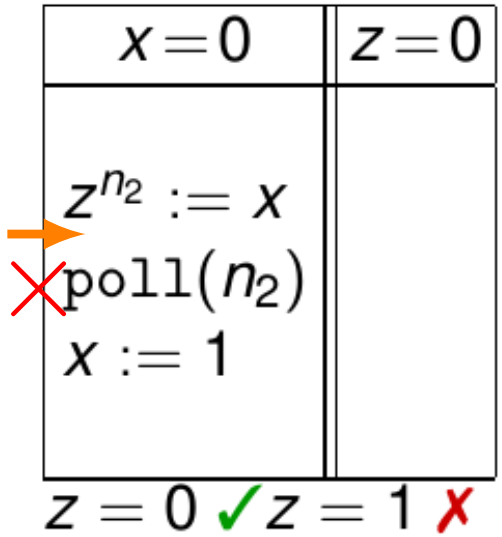

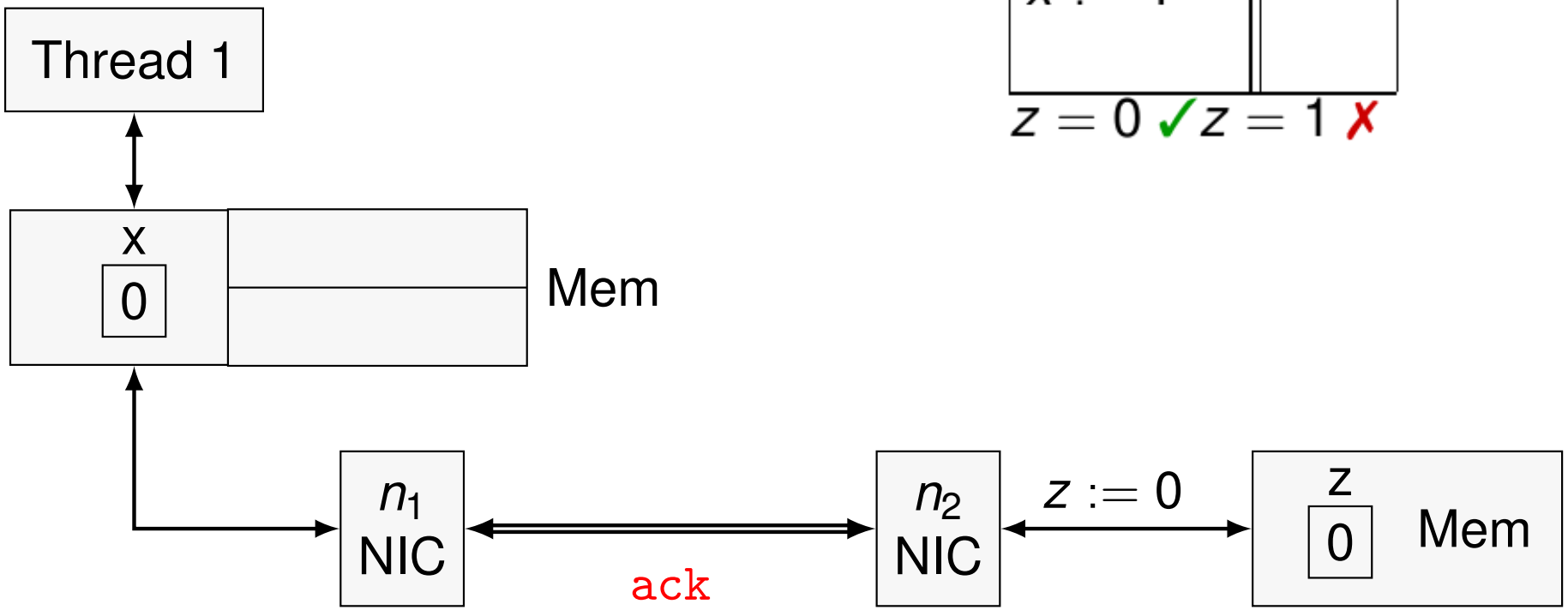

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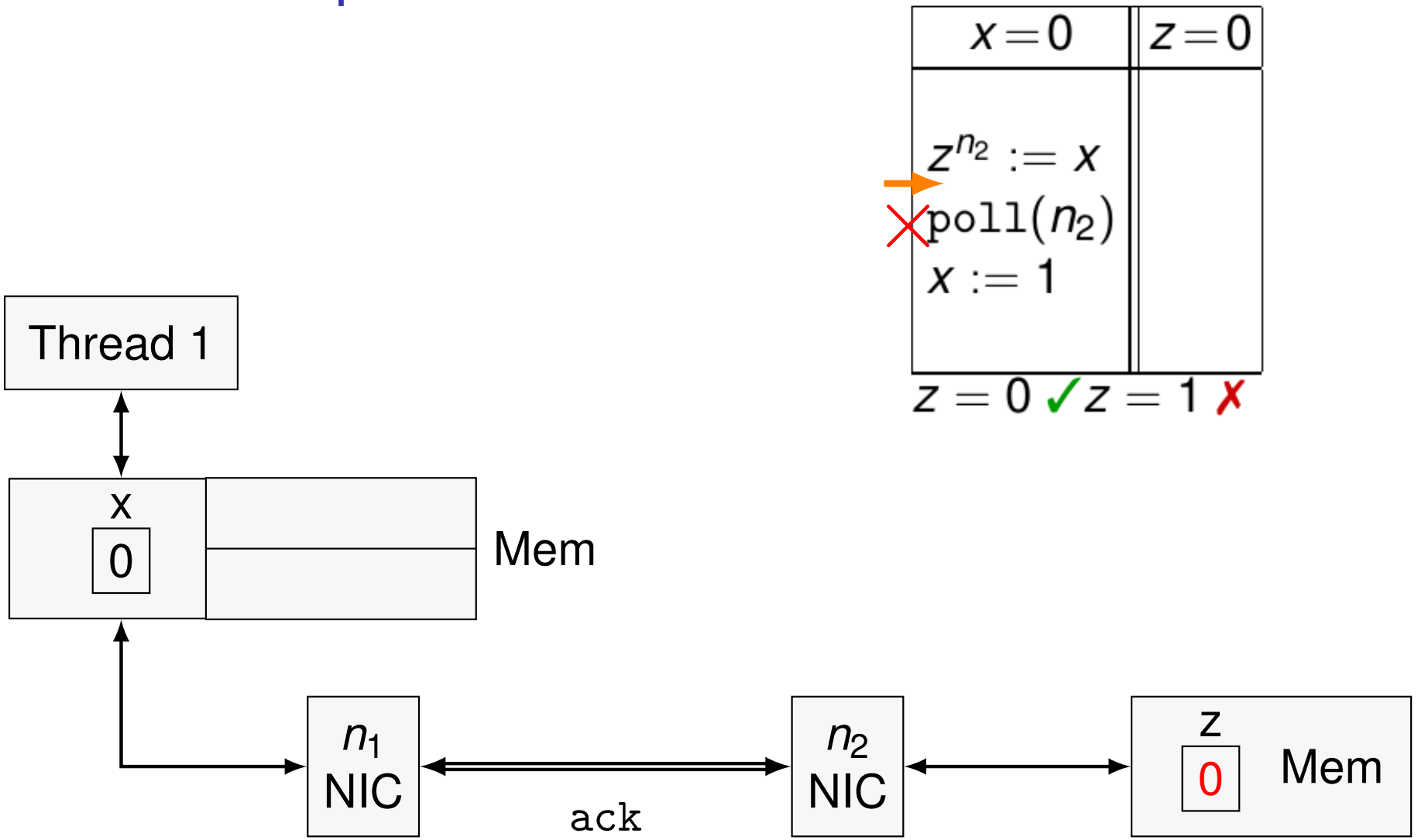

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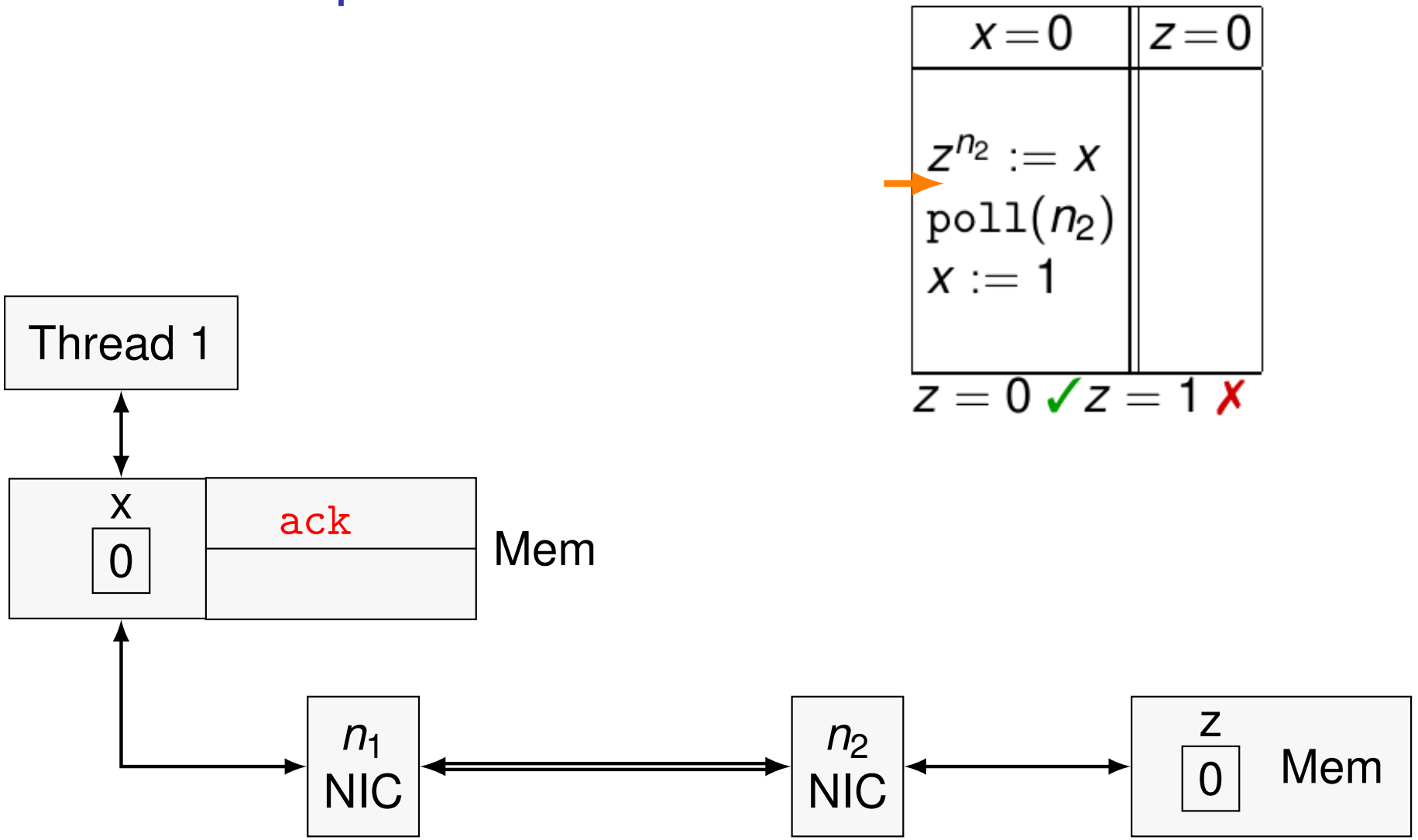

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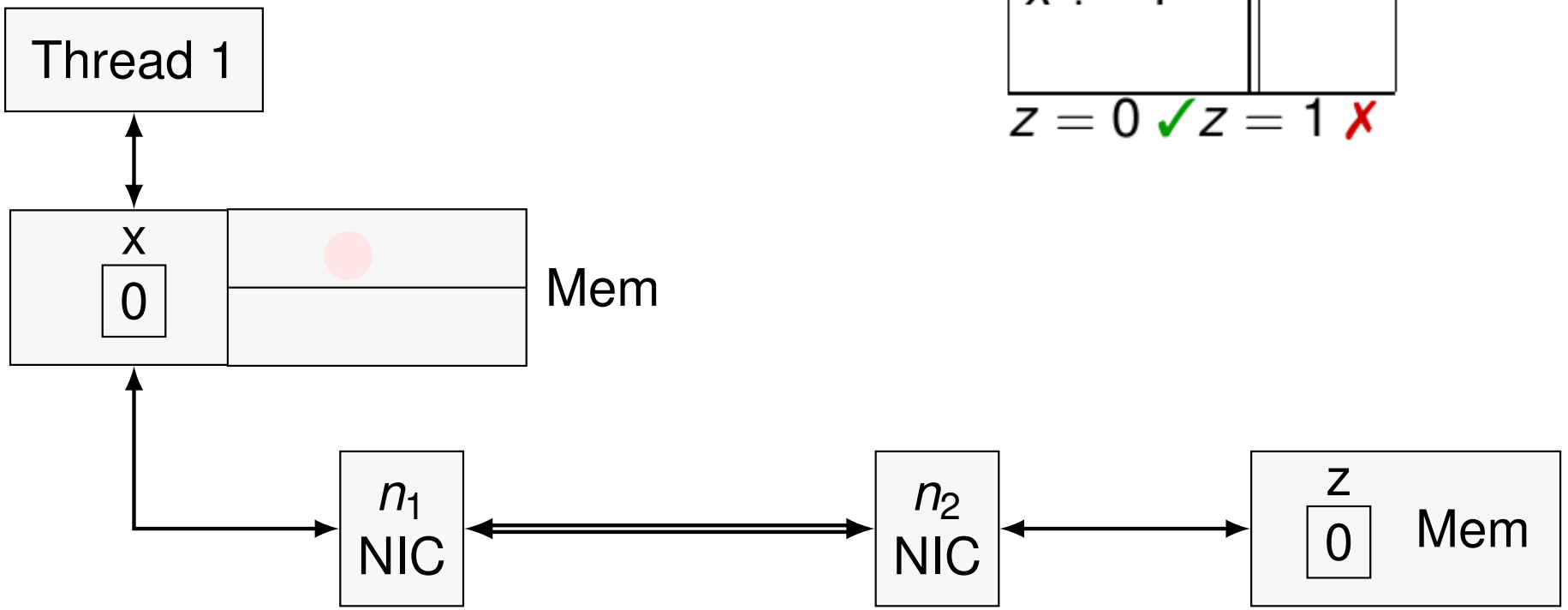

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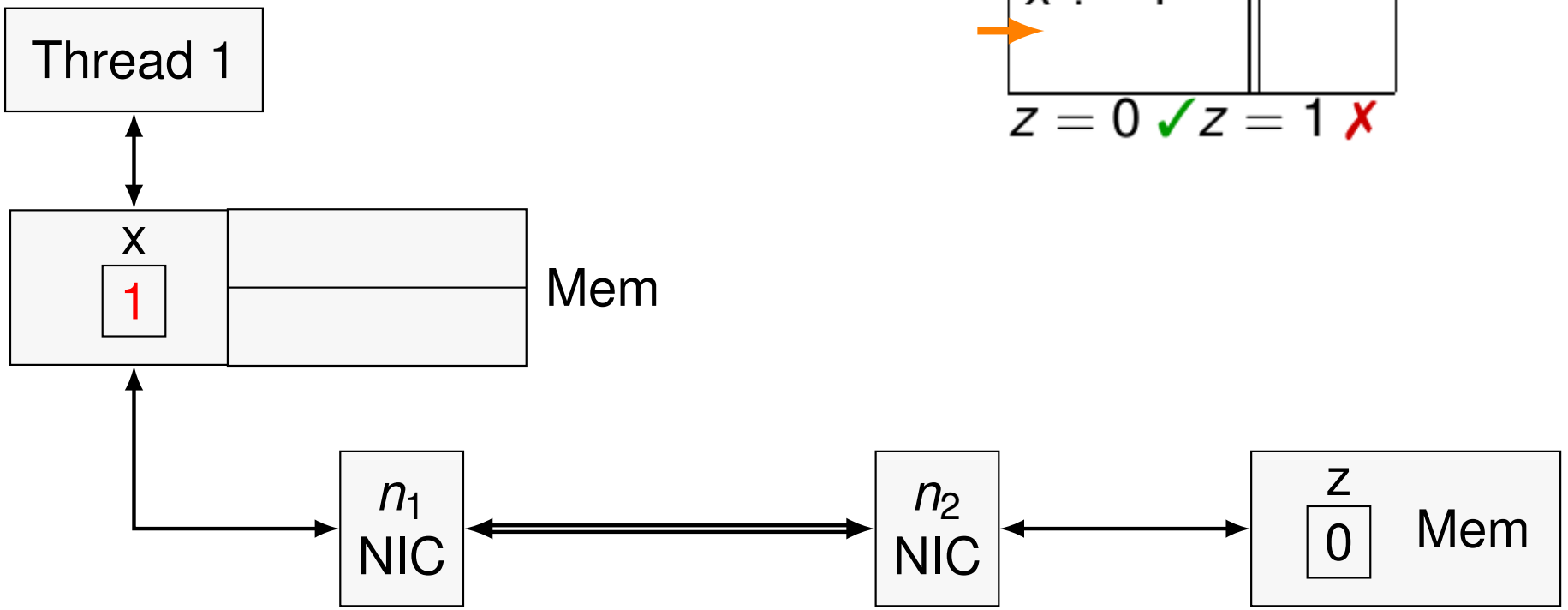


DONE: formalising RDMA semantics

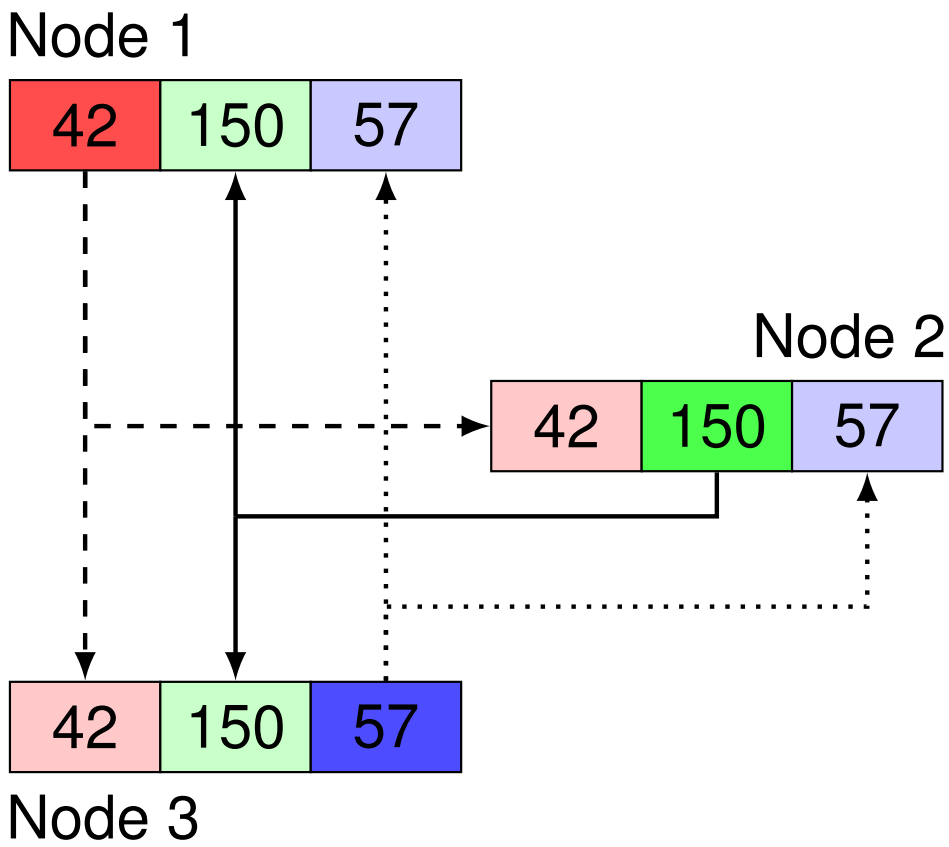
Operational Semantics Formalised in Coq:

- nodes and threads
- x86-TSO store buffers
- IB Verbs (API used by the CPU)
- internal semantics

WIP: defining shared data structures

Example:
Shared State Table (SST)[1]

Each node has a value and a copy of other nodes values



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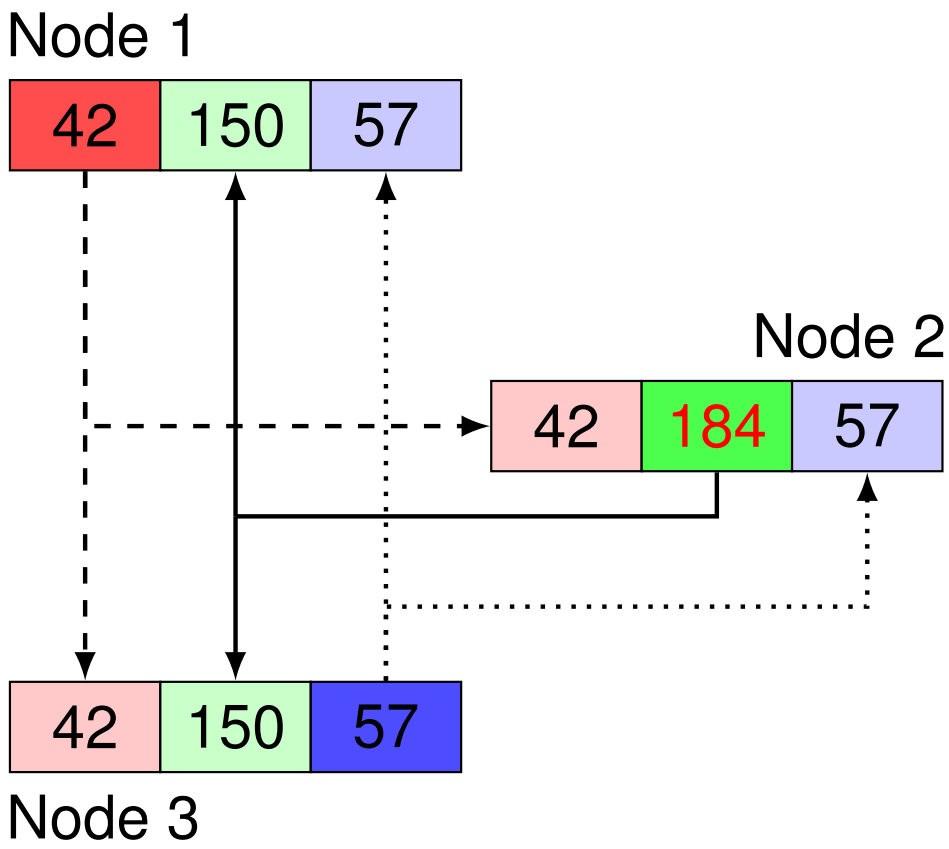

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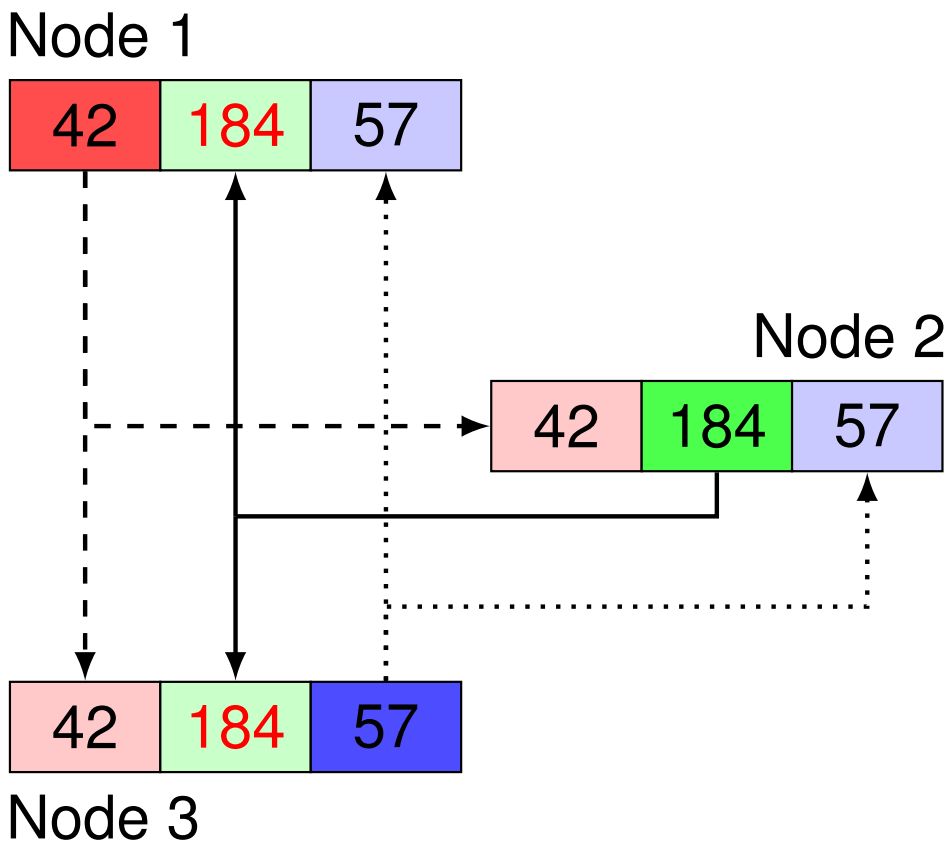

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FUTURE: certifying functions

Example: barrier

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barrier():
1   val <- val+1
2   broadcast(val)
3   waiting <- true
4   while (waiting):
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6     for n in remotes:
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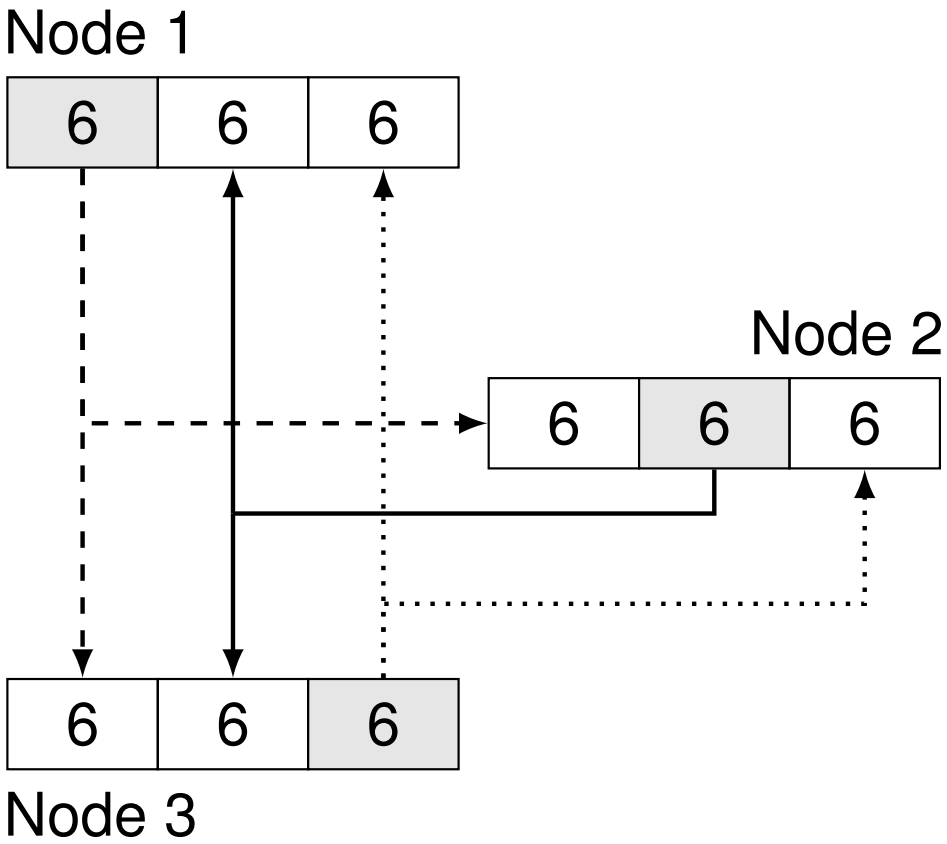

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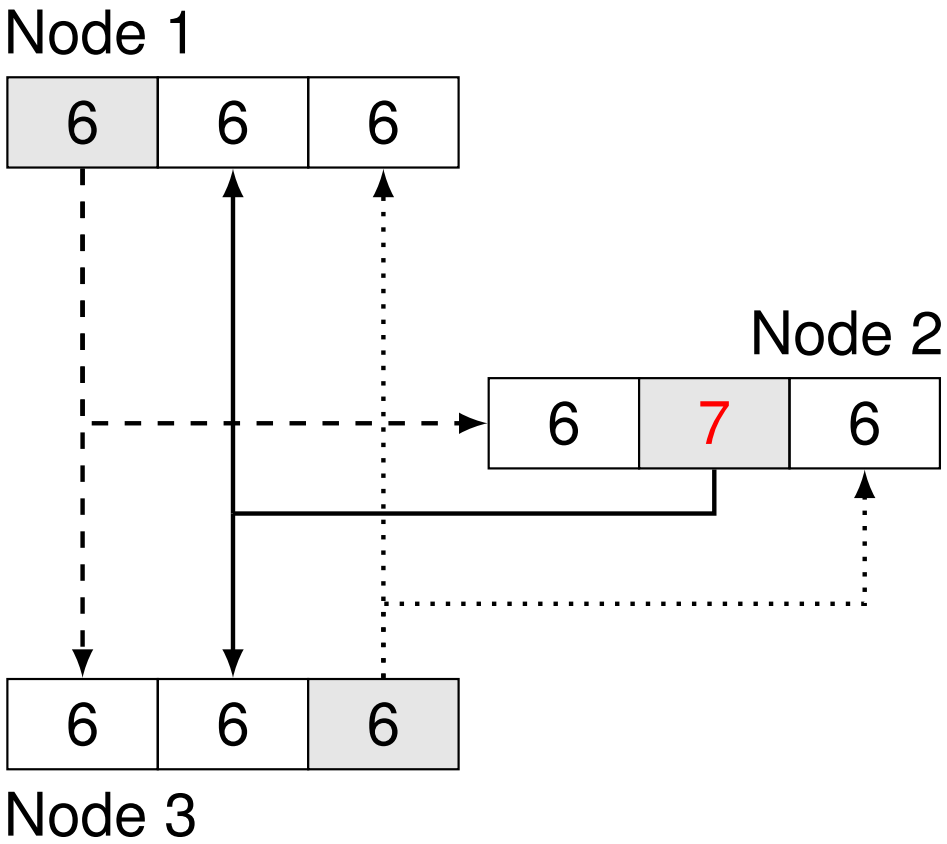

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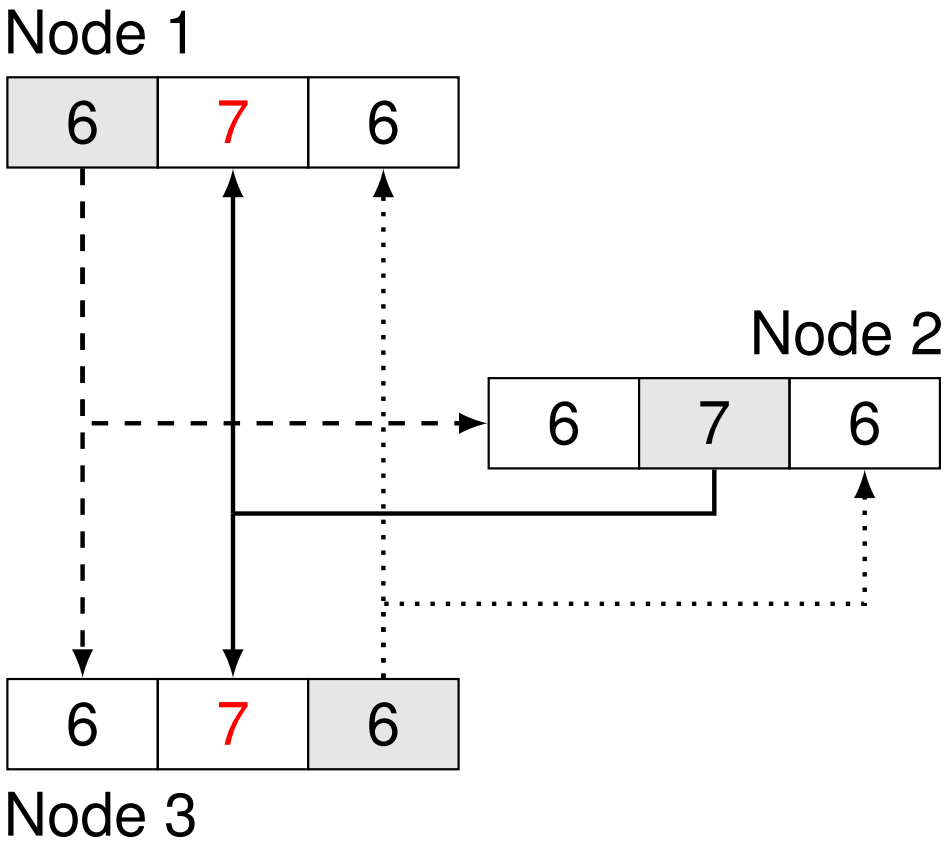

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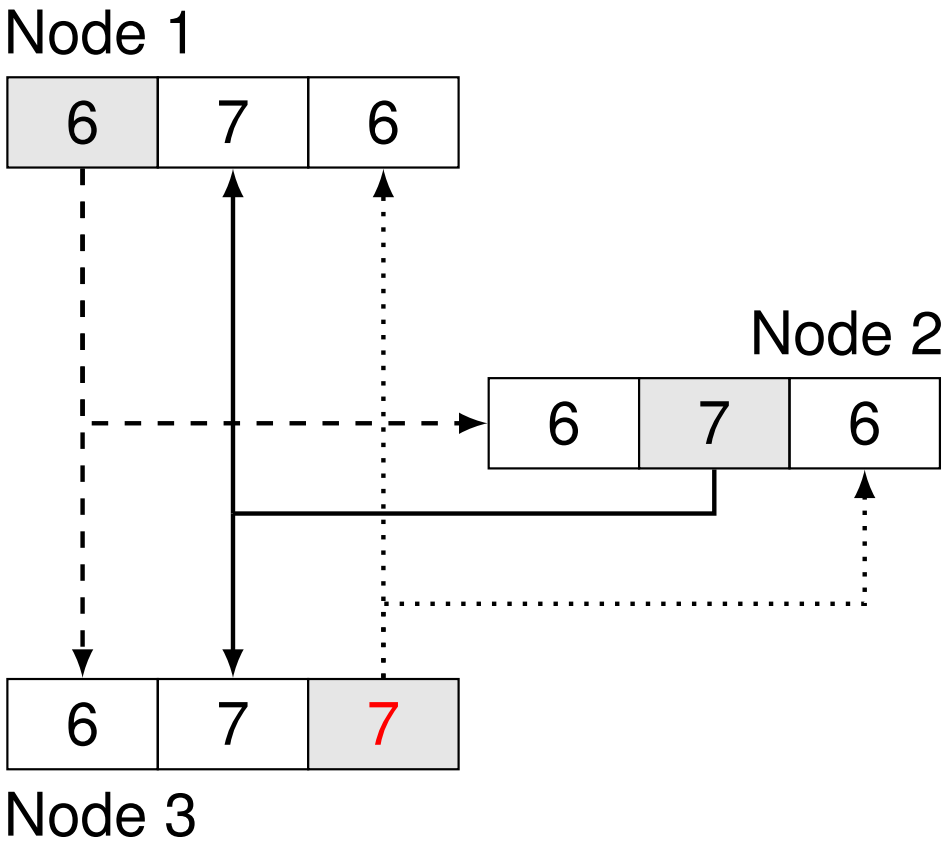

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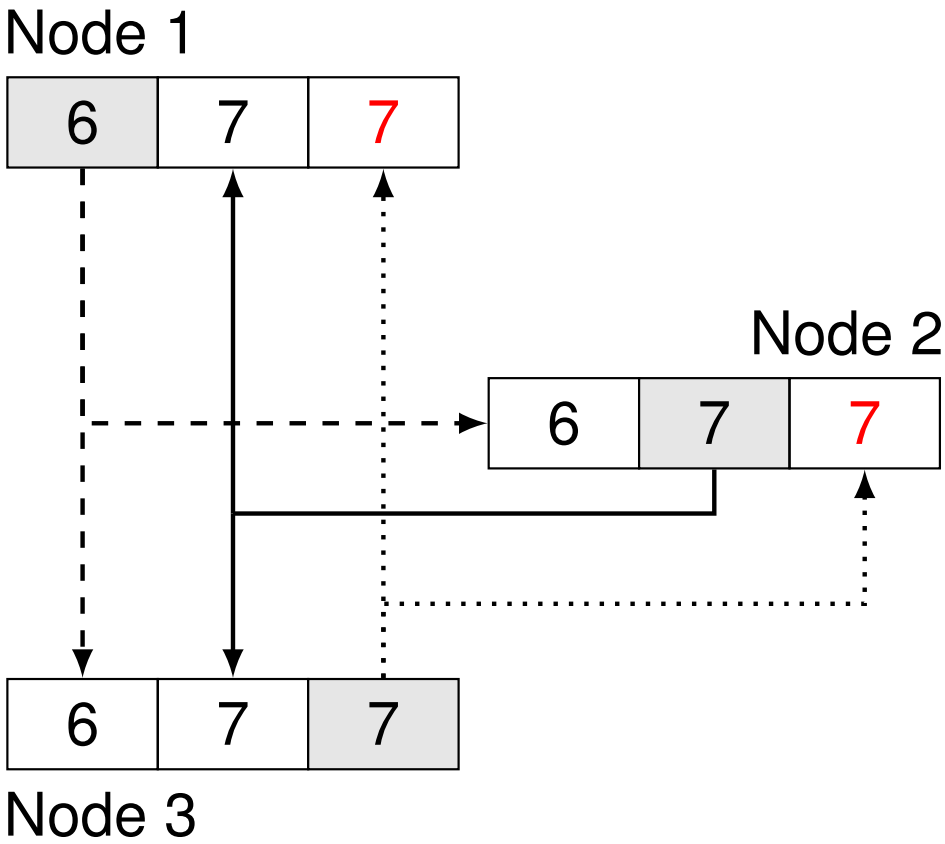

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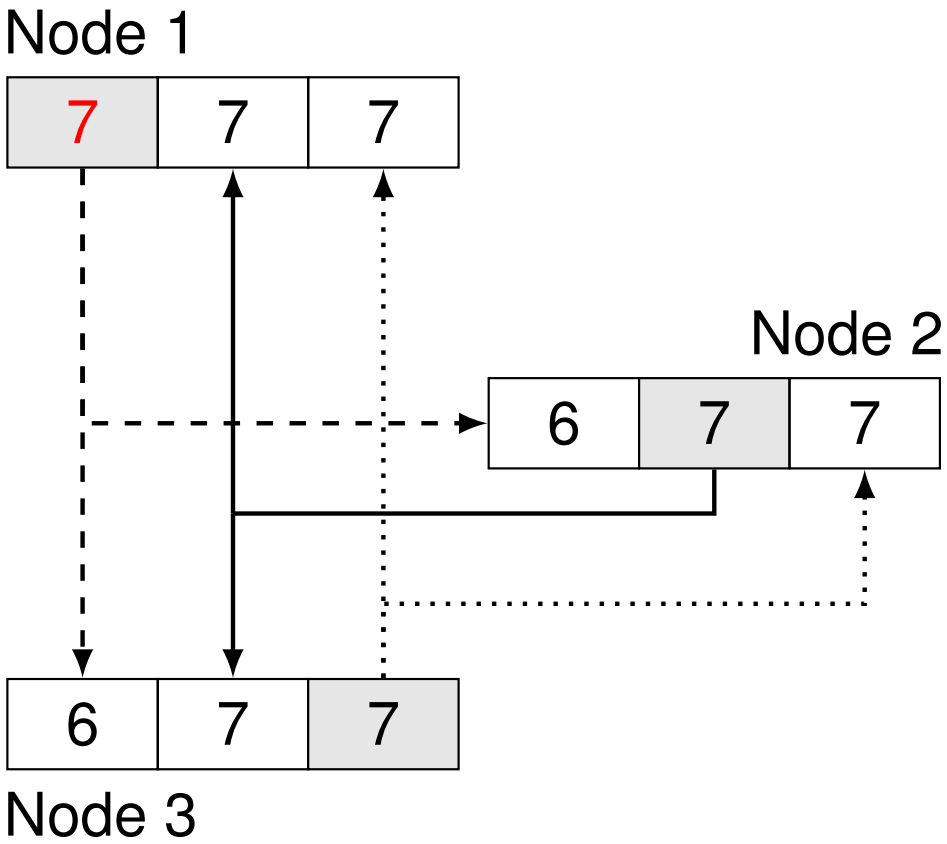

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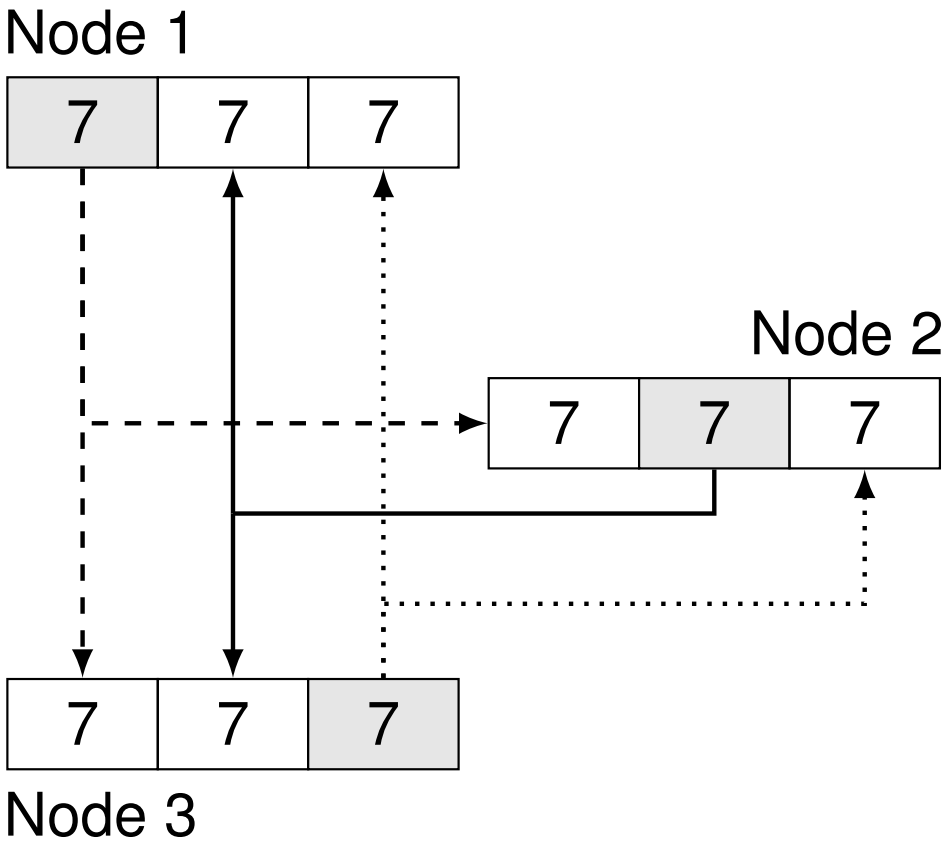

Summary

Context:

- Old technology for fast data transfer with obscure semantics
- Getting cheaper and usable for more applications
- In need of support for formal verification

Our work:

- DONE: formalisation of the base RDMA semantics
- WIP: formalising shared data structures of libraries
- FUTURE: certifying functions/programs